Printed Name

Nine-digit GT ID

signature

Fall 2019 **PHYS 2212 GJ** **Test 03**

Test Form: **3A**

- Put nothing other than your name and nine-digit GT ID in the blocks above. Print clearly so that OCR software can properly identify you. Sign your name on the line immediately below your printed name.
- Free-response problems are numbered I–III. Show all your work clearly, including all steps and logic. Write darkly. Blue or black ink is recommended. Do not make any erasures in your free-response work. Cross out anything you do not want evaluated. Box your answer.
- Multiple-choice questions are numbered 1–6. For each, select the answer most nearly correct, circle it on yourtest, and fill the bubble for your answer on this front page.
- Initial the odd pages in the top margin, in case the pages of your quiz get separated.
- The standard formula sheet is on the back of this page, which may be removed from the quiz form if you wish, but it must be submitted.
- If the page for a free-response problem has insufficient space for your work, ask a proctor for an additional sheet. If you wish this work to be evaluated, put your name on the sheet and make a note on the problem page, so graders know where to find your work. Place any added pages at the **back** of your test, when submitting your exam.
- You may use a calculator that cannot store letters, but no other aids or electronic devices.
- Scores will be posted when your test has been graded. Test grades become final when the next is given.

Fill in bubbles for your Multiple Choice answers darkly and neatly.
If you wish to change an answer, draw a clear "X" through the non-answer!

1 ⓐ ⓑ ⓒ ⓓ ⓔ

2 ⓐ ⓑ ⓒ ⓓ ⓔ

3 ⓐ ⓑ ⓒ ⓓ ⓔ

4 ⓐ ⓑ ⓒ ⓓ ⓔ

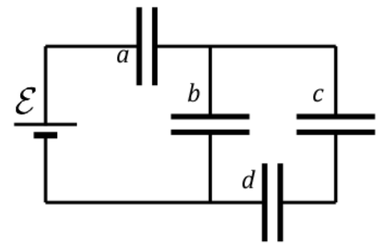
5 ⓐ ⓑ ⓒ ⓓ ⓔ

6 ⓐ ⓑ ⓒ ⓓ ⓔ

Extra Worksapace: If you use this space for a free-response problem, be sure to point it out on that problem's page!

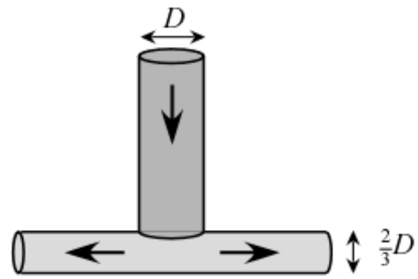
The following problem will be hand-graded. Show all supporting work for this problem.

[I] *(20 points)* Four identical capacitors C are hooked up to form the network shown at right. Determine the potetnial across capacitor *d*. Express your answer as a fraction of $\mathcal{E}$.



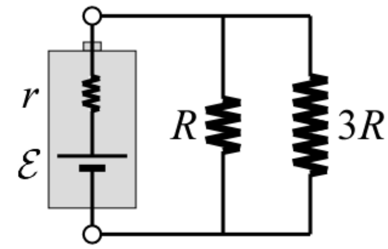
The following problem will be hand-graded. *<u>Show all supporting work for this problem</u>.*

[II] *(20 points)* A gold wire having diameter D and conductivity σ carries a current I. The current flows into a T-junction with a silver wire having diameter $\frac{2}{3}D$ and conductivity $\frac{3}{2}\sigma$. Compare the electric field mangitudes in the two wires, by expressing the electric field strength in the silver wire as a numerical multiple or fraction of the electric field strength in the gold wire.



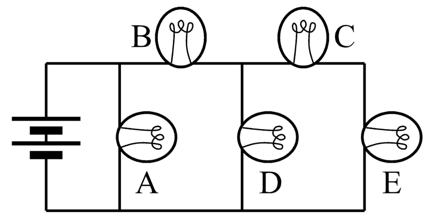
The following problem will be hand-graded. Show all supporting work for this problem.

[III] *(20 points)* In the circuit at right, a real battery with unknown internal resistance *r* is hooked up to the two-resistor network shown. It is found that the net power output of the battery is $P_{out} = \frac{3}{4}\mathcal{E}^2/R$. What is the internal resistance of the battery? Express *r* as a fraction or multiple of *R*.



Question value 8 points

(01) In the circuit at right, all bulbs are identical. Rank, from greatest to least, the brightness of the five bulbs.

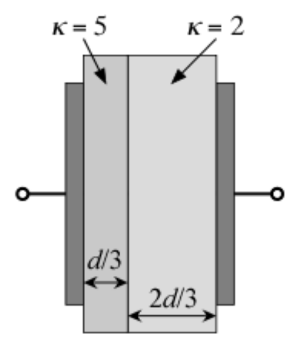


(a) A > B > D > C = E
(b) A = B > C > D = E
(c) A > B = C > D > E
(d) B = C > A = D = E
(e) A > B = D > C = E

Question value 8 points

(02) A capacitor with plate separation *d* has a vacuum capacitance C_o. A two-layer dielectric is inserted into the capacitor, consisting of a pyrex slab (dielectric constant $\kappa = 5.0$) of thickness *d*/3, and a teflon slab (dielectric constant $\kappa = 2.0$) of thickness 2*d*/3. In terms of the vacuum value, what is the capacitance with the dielectric inserted?

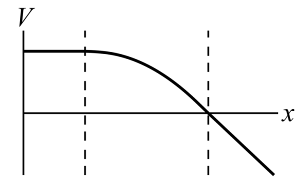
Hint:what is the electric field inside each dielectric, when the capacitor is charged?

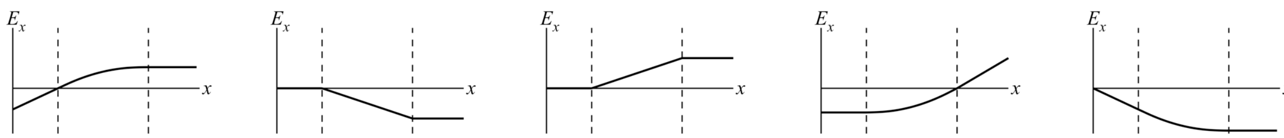


(a) 2.0 C_o
(b) 2.5 C_o
(c) 3.5 C_o
(d) 3.0 C_o
(e) 1.5 C_o

Question value 8 points

(03) In a region of space, the electric field depends only on x, with a functional value given by the graph at right. Which of the following plots accurately characterizes the electric field in this region of space?

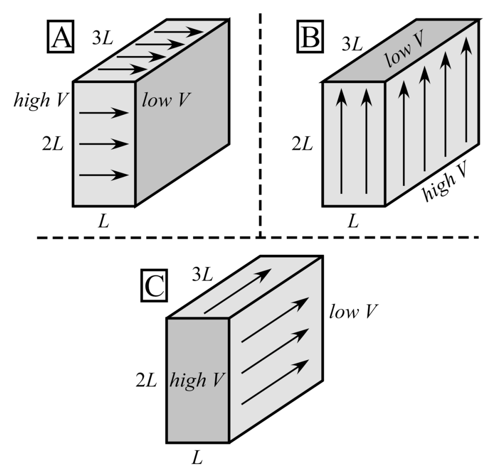




(a) (b) (c) (d) (e)

Question value 8 points

(04) A slab of material having resistivity ρ has dimensions $L \times 2L \times 3L$, as shown at right. The slab can be configured to drive a current left-to-right (diagram A), bottom-to-top (diagram B), or front-to-back (diagram C). Assuming the same potential difference is applied in each case, rank from greatest to least the currents in the three situations.



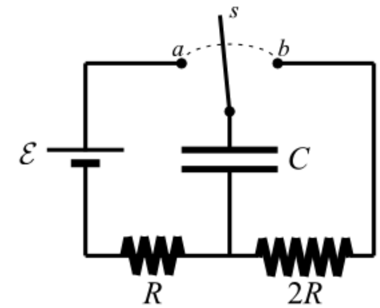
(a) $I_B > I_A > I_C$

(b) $I_C > I_B > I_A$

(c) $I_A = I_B = I_C$

(d) $I_B > I_C > I_A$

(e) $I_A > I_B > I_C$



The next two questions involve the following situation:

In the circuit at right, capacitor C is initially uncharged with the switch in the neutral position s. At time zero, the switch is moved to position a, charging the capacitor through the left-hand loop. At time $t_1 = 2RC$, the switch is moved to position b, discharging the capacitor through the right-hand loop.

Question value 4 points

(05) What is the charge on the capacitor, at the moment the switch is moved from a to b?

(a) $0.500\ C\mathcal{E}$

(b) $0.865\ C\mathcal{E}$

(c) $0.135\ C\mathcal{E}$

(d) $0.607\ C\mathcal{E}$

(e) $0.250\ C\mathcal{E}$

Question value 4 points

(06) Letting Q_s represent the charge on the capacitor when the switch is flipped, what will be the initial current in the discharge circuit, just after the switch is flipped?

(a) $I_0 = \frac{Q_s}{2RC}$

(b) $I_0 = \frac{Q_s}{3R}$

(c) $I_0 = 0$

(d) $I_0 = \frac{Q_s}{3RC}$

(e) $I_0 = \frac{Q_s}{2C}$